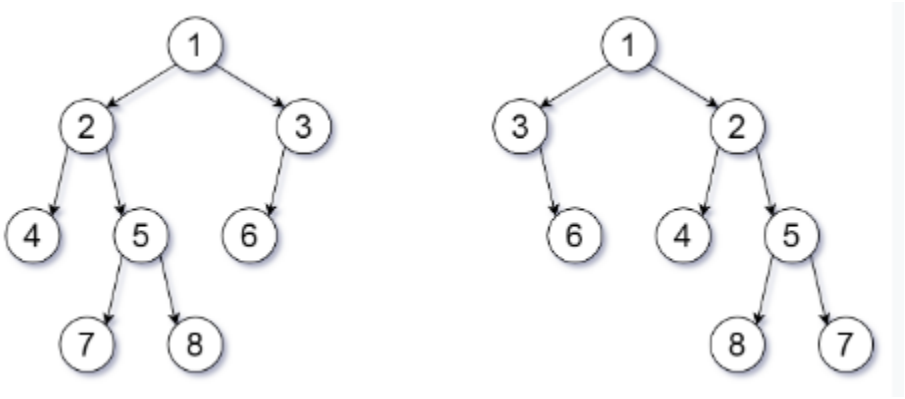
Flip Equivalent Binary Trees

For a binary tree T, we can define a flip operation as follows: choose any node, and swap the left and right child subtrees. A binary tree X is flip equivalent to a binary tree Y if and only if we can make X equal to Y after some number of flip operations. Write a function that determines whether two binary trees are flip equivalent. The trees are given by root nodes root1 and root2.

Example 1:

Input: root1 = [1,2,3,4,5,6,null,null,null,7,8], root2 = [1,3,2,null,6,4,5,null,null,null,null,8,7]
Output: true
Explanation: We flipped at nodes with values 1, 3, and 5.
Flipped Trees Diagram



Note:

1. Each tree will have at most 100 nodes.
2. Each value in each tree will be a unique integer in the range [0, 99].

Solution in C++

```
/**
 * Definition for a binary tree node.
 * struct TreeNode {
 *     int val;
 *     TreeNode *left;
 *     TreeNode *right;
 *     TreeNode(int x) : val(x), left(NULL), right(NULL) {}
 * };
 */
class Solution {
public:
    int ChildSum(TreeNode *node) {
        if (!node) return 0;

        int sum=0;
        if (node->left) sum += node->left->val;
        if (node->right) sum += node->right->val;
        return sum;
    }

    int ChildVal(TreeNode *node) {
        if (node) return node->val;
        return 0;
    }

    bool flipEquiv(TreeNode* root1, TreeNode* root2) {
        if (!root1 && !root2) return true;
        if (ChildVal(root1) != ChildVal(root2)) return false;
        if (ChildSum(root1)!=ChildSum(root2)) return false;

        if (root1->left) {
            if (root2->left && ChildVal(root1->left)==ChildVal(root2->left))
                return flipEquiv(root1->left, root2->left) && flipEquiv(root1->right, root2->right);
            else
                return flipEquiv(root1->left, root2->right) && flipEquiv(root1->right, root2->left);
        }
        else if (root1->right) {
            if (root2->right && ChildVal(root1->right)==ChildVal(root2->right))
                return flipEquiv(root1->right, root2->right) && flipEquiv(root1->left, root2->left);
            else
                return flipEquiv(root1->right, root2->left) && flipEquiv(root1->left, root2->right);
        }
        return true;
    }
};
```

Solution in Java based on Recursion

```
class Solution(object):
    def flipEquiv(self, root1, root2):
        if root1 is root2:
            return True
        if not root1 or not root2 or root1.val != root2.val:
            return False

        return (self.flipEquiv(root1.left, root2.left) and
                self.flipEquiv(root1.right, root2.right) or
                self.flipEquiv(root1.left, root2.right) and
                self.flipEquiv(root1.right, root2.left))
```

Solution in Python based on Recursion

```
class Solution(object):
    def flipEquiv(self, root1, root2):
        if root1 is root2:
            return True
        if not root1 or not root2 or root1.val != root2.val:
            return False

        return (self.flipEquiv(root1.left, root2.left) and
                self.flipEquiv(root1.right, root2.right) or
                self.flipEquiv(root1.left, root2.right) and
                self.flipEquiv(root1.right, root2.left))
```

Solution in Java based on Canonical Traversal

```
class Solution {
    public boolean flipEquiv(TreeNode root1, TreeNode root2) {
        List<Integer> vals1 = new ArrayList();
        List<Integer> vals2 = new ArrayList();
        dfs(root1, vals1);
        dfs(root2, vals2);
        return vals1.equals(vals2);
    }

    public void dfs(TreeNode node, List<Integer> vals) {
        if (node != null) {
            vals.add(node.val);
            int L = node.left != null ? node.left.val : -1;
            int R = node.right != null ? node.right.val : -1;

            if (L < R) {
                dfs(node.left, vals);
                dfs(node.right, vals);
            } else {
                dfs(node.right, vals);
                dfs(node.left, vals);
            }

            vals.add(null);
        }
    }
}
```

Solution in Python based on Canonical Traversal

```
class Solution:
    def flipEquiv(self, root1, root2):
        def dfs(node):
            if node:
                yield node.val
                L = node.left.val if node.left else -1
                R = node.right.val if node.right else -1
                if L < R:
                    yield from dfs(node.left)
                    yield from dfs(node.right)
                else:
                    yield from dfs(node.right)
                    yield from dfs(node.left)
                yield '#'

        return all(x == y for x, y in itertools.zip_longest(
            dfs(root1), dfs(root2)))
```